

CLAIMS (Proposal for preliminary amendment)

1. A method for acquiring optical near-field interaction  
signals in the infrared spectral region, comprising the  
steps of:
  - illumination of an object combination comprising at  
least two objects with infrared radiation so that  
an infrared near-field coupling is generated be-  
tween the objects; and
  - acquisition the scattered light which is scattered  
by the object combination, which scattered light  
comprises a fraction (s) that has been modified as  
a result of the near-field coupling, wherein
  - at least one of the objects comprises a polar mate-  
rial which at least in part comprises a polar  
solid-state structure; and
  - during illumination in at least one of the objects  
with the polar material at least one phonon reso-  
nance is excited with which the modified fraction  
(s) of the scattered light is strengthened.
2. The method according to claim 1, in which acquiring the  
modified fraction (s) comprises infrared detection with  
a detector device.
3. The method according to claim 2, in which one of the ob-  
jects which forms a sample comprises a solid-state sur-  
face, an adsorbate on a solid-state surface, or a solid,  
liquid or gaseous volume material.
4. The method according to claim 2, in which one of the ob-  
jects which forms a probe comprises a scanning tip of a  
near-field microscope, a reading head or at least one  
particle embedded, or suspended in a solid, liquid or  
gaseous material.
5. The method according to claim 4, in which for optical  
near-field microscopy the probe and a sample which is to

be examined and which forms the associated second object of the object combination are moved step by step relative to each other, and in which method spatially resolved detection of the modified fraction (s) takes place.

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6. The method according to claim 4, in which, for optical near-field microscopy, illumination of the object combination takes place with infrared radiation of different wavelengths, wherein in each case spectrally specific detection of scattered light occurs.

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7. The method according to claim 4, in which the fraction of the measured scattered light, which fraction has been modified by the near-field coupling, is subjected to spectral analysis.

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8. The method according to claim 4, in which, for the purpose of reading out optically stored data, the probe as a reading head is moved over a data carrier which forms the associated second object of the object combination, and detection of a data structure takes place, which data structure has been placed onto, impressed into, or arranged underneath the surface of the data carrier.

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9. The method according to claim 5, in which the sample or the data carrier comprises a topography-free surface which comprises structures with differences in the refractive index and with characteristic dimensions which are smaller than 10  $\mu\text{m}$ .

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10. The method according to claim 1, in which the acquisition of the modified fraction (s) comprises resonant excitation of at least one adjacent object of a polar material.

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11. The method according to claim 10, in which with the acquisition of the modified fraction (s) at least one row

of objects out of a multitude of objects of a polar material is resonantly excited.

- 5 12. The method according to claim 11, in which with the acquisition of the modified fraction (s) several rows of objects of a polar material can be resonantly excited, which rows are interconnected by means of at least one branch.
- 10 13. The method according to claim 10, in which physical characteristics, in particular the crystal structure, band structure or charge carrier density of at least one object or of a surrounding of at least one object, are modulated with electromagnetic, electric or magnetic  
15 fields so that the dielectric characteristics of the object are changed and the modified fraction (s) of the scattered light which is scattered on the object is modulated accordingly.
- 20 14. The method according to claim 13, in which the physical characteristics of the respective object or of its surroundings are modified with high-frequency or low-frequency electromagnetic fields.
- 25 15. The method according to claim 12, in which the physical characteristics of an object which is arranged on a branch are modified.
- 30 16. The method according to claim 13, in which the modulation of the modified fraction (s) of the scattered light is detected and used as an optical switching signal or for near-field illumination of further object combinations.
- 35 17. The method according to claim 1, in which the polar material comprises a III-V-, IV-IV- or II-VI-semiconductor.

18. The method according to claim 1, in which the polar material comprises a ferroelectrical material (e.g. barium titanate), SiC, Si<sub>3</sub>N<sub>4</sub>, CaPO<sub>3</sub>, CaCO<sub>3</sub> or SiO<sub>2</sub>.
- 5 19. A method for infrared spectroscopic examination of a sample, which comprises several components or phases, in which the sample is subjected to scattered-light detection by means of a method according to claim 1, and the components or phases are acquired or analysed depending  
10 on the occurrence of specific phonon resonances.
20. A measuring arrangement for measuring the scattered light in the infrared spectral region, comprising:
- 15 - an illumination device for generating infrared radiation;
  - a probe device which is arranged so as to be movable at some distance from a sample or so as to be in a sample; and
  - 20 - a detector unit with which the infrared radiation scattered on the probe device is detectable, wherein
  - the probe device comprises at least one probe which at least partly comprises a material with a polar solid-state structure.
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21. The measuring arrangement according to claim 20, in which the probe comprises a III-V-, IV-IV- or II-VI-semiconductor.
- 30 22. The measuring arrangement according to claim 20, in which the probe comprises a ferroelectrical material (e.g. barium titanate), SiC, Si<sub>3</sub>N<sub>4</sub>, CaPO<sub>3</sub>, CaCO<sub>3</sub> or SiO<sub>2</sub>.
- 35 23. The measuring arrangement according to claim 20, which is designed as an optical near-field microscope with a scanning tip which carries the probe, and a laser-detector combination for controlling the position of the scanning tip.

24. The measuring arrangement according to claim 20, which is designed as a reading device for an optical data storage device.

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25. The measuring arrangement according to claim 20, which is designed as a chemical or physical sensor device.

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26. An optical modulator for acquiring or processing optical near-field interaction signals in the infrared spectral region, comprising:

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- at least two objects which are arranged on a substrate; and
- an illumination device for illuminating the objects with infrared radiation, wherein
- the distance between the objects is so short that infrared-near coupling between the objects is produced as a result of radiation,

characterised in that

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- at least one of the objects consists at least in part of a material that has a polar solid-state structure; and

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- at least one of the objects is connected to a modulator device for the modulation of physical characteristics, in particular crystal structure, band structure or charge carrier density of the object, of which there is at least one, or of a surrounding of the object of which there is at least one with electromagnetic, electric or magnetic fields.

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27. The optical modulator according to claim 26 which comprises at least one detector device with which the infrared radiation scattered on the objects is detectable.

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28. The optical modulator according claim 26, in which at least one row comprising a multitude of objects of a polar material is provided, which objects, when at least

one combination of two adjacent objects is illuminated, are mutually excitable so as to be resonant.

- 5 29. The optical modulator according to claim 28, in which several rows of objects are provided which are interconnected by way of at least one branch.
- 10 30. The optical modulator according to claim 26, in which the objects comprise a III-V-, IV-IV- or II-VI-semiconductor.
- 15 31. The optical modulator according to claim 26, in which the objects comprise a ferroelectrical material (e.g. barium titanate), SiC, Si<sub>3</sub>N<sub>4</sub>, CaPO<sub>3</sub>, CaCO<sub>3</sub> or SiO<sub>2</sub>.
32. The optical modulator according to claim 26 which forms an optical circuit.
- 20 33. The optical modulator according to claim 26, in which the illumination device and/or the detector device are/is arranged on the substrate.